STUDIES IN MANURIAL VALUES OF SEAWEEDS

II. EFFECTS OF PACHYMENIA HIMANTOPHORA AND DURVILLEA ANTARCTICA ON THE IMMOBILISATION OF NITROGEN IN SOIL

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INTRODUCTION

The results of growth-trial experiments carried out under glasshouse conditions reported in the previous paper (Francki 2) indicated that plants grown on soils freshly treated with dry meal from Durvillea antarctica, a seaweed species with high C/N ratio, may have been suffering from inadequate nitrogen supplies. It was suggested that this may have been due to biological immobilization of the inorganic nitrogen present in the soil. Pachymenia himantophora, the other seaweed species used, had a higher nitrogen content and did not induce any signs of nitrogen starvation in plants. This paper reports results of investigations into the levels of inorganic nitrogen and microbiological activity in soils following seaweed treatment.

METHODS

Glasshouse trials
The techniques used in growth trials were identical with those already reported (Francki 2).

The soil-percolation technique
With the exception of the air-supply equipment, the apparatus used was essentially like that of Lees 3. Sterile, moist air was supplied intermittently by an electric pump, switched on and off by a simmerstat, through two winchester bottles of scrubbing fluid (5% w/v copper sulphate in 2.5% v/v...
sulphuric acid) into twelve percolators housed in a constant-temperature cabinet kept at 25 ± 1°C.

Fresh soil samples brought up to field capacity, and equivalent to 50 g dry weight, plus 200 ml of fluid were used in each percolator. Before samples of the percolation fluid were removed for analysis, evaporation losses were compensated for by adding distilled water; the quantities required were always small. No compensations were made for the volumes of liquid withdrawn as samples but after each sample was taken the air supply to each percolator was re-adjusted to ensure steady percolation. This procedure had the disadvantage of decreasing the ratio of perfusate volume to soil volume; on the other hand, progressive dilution of the perfusate was avoided. For purely comparative purposes, as in this work, this procedure was quite adequate.

Using this technique the nitrogen changes in three soils, each untreated and treated with seaweed meals at the rate of 1.25 per cent, was followed over periods of 70 days. At the commencement of each experiment the percolation fluid consisted of a solution of ammonium nitrate and di-ammonium hydrogen phosphate which gave concentrations of 110 ppm ammonium nitrogen, 100 ppm nitrate nitrogen and 11 ppm phosphate phosphorus * respectively. In the soil, nitrate and nitrite ions are considered to be present exclusively in solution and thus, by analysing the perfusate, their formation or destruction in the soil can be estimated accurately. Ammonium ions, however, are partly in solution and partly adsorbed on to the soil colloidal particles so that the analysis of the perfusate only accounts for a portion of them. Lees and Quastel have shown experimentally that the ammonium "adsorption ratio" ** remains reasonably constant throughout a normal nitrification experiment and hence for comparative purposes it is sufficient to analyse the perfusate only for ammonium nitrogen. The total inorganic nitrogen was calculated by adding the values obtained for ammonium nitrogen and nitrate nitrogen in the perfusate. The nitrite content was always found to be very low in relation to the ammonium and nitrate and was therefore ignored.

Analytical techniques

The ammonium and nitrite concentrations were estimated colorimetrically by the Nessler and α-naphthylamine-sulphanilic acid methods respectively on small samples of the perfusate (0.5 to 3 ml, according to the concentrations present) diluted to 25 or 50 ml. The colour intensities were read on a Hilger Spekker absorptiometer.

The nitrate was estimated by a modification of the indigo method described by Sutton. A sample of perfusate (0.5 to 3 ml) was made up to

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* Phosphate was added in the hope of simultaneously following the phosphorus metabolism of the soils; experimental difficulties made this impossible.

** The ammonium "adsorption ratio" is defined by Lees as:

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\frac{\text{Ammonium nitrogen bound in soil exchange complex}}{\text{Total ammonium nitrogen in the system}}
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